18-36V Input, 3.3V/25A Output Sixteenth Brick

Features

- **Wide input voltage range: 18 – 36V**
- **High Efficiency: 91.5% at 3.3V/25A output**
- **Optimal thermal performance**
- **Remote sense, On/Off control,**
- **Over-voltage, over-current, short-circuit, and over temperature protection**
- **Monotonic start-up into pre-biased load**
- **1,500V isolation voltage**

For High Reliability Applications

Options

- **Open-frame, Baseplate, or Encapsulated**
- **Auto-restart or lock-up protection mode**
- **Negative / Positive enable logic**

Part Numbering System

SA	24	X	033	X	025	X	X	X	X
Series Name	Nominal Input Voltage	Temperature Grade（Baseplate Temperature）	Output Voltage	Enabling Logic	Rated Output Current	Pin Length	Electrical Option	Mechanical Options	Lead-free, ROHS Compliant
VSA	24: 18-36V	C: -40C--80C H: -40C--100C M: -55C--100C	Unit: .01V 033: 3.3V	P: Positive N: Negative	Unit: A 025: 25A	R: 0.180"	0: Lock-up 2: Auto-restart	0: Open-frame 1: Baseplate 2: Encapsulated 3:with mounting holes	G: Lead-free

General Specification

Absolute Maximum Rating

Excessive stresses over these absolute maximum ratings can cause permanent damage to the converter. Also, exposure to absolute maximum ratings for extended periods of time can adversely affect the reliability of the converter. Operation should be limited to the conditions outlined under the Electrical Specification Section.

Parameter	Symbol	Min	Max	Unit
Input Voltage (continuous)	Vi	-0.5	40	Vdc
Transient Input Voltage (<100ms continuous operating)	$V_{i,trans}$	-	50	Vdc
I/O Isolation Voltage (for 1 minute)			1,500	Vdc
Operating Ambient Temperature	To			
"C" Temperature grade		-40	80	˚C
"H" Temperature grade		-40	100	˚C
"M" Temperature grade		-55	100	˚C
Storage Temperature	Tstg	-55	125	˚C

Electrical Specifications

The specifications are valid over all operating conditions including input voltage, resistive load, and temperature except as noted.

Input Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Input Voltage	Vi	18	24	36	Vdc
Input Current	$I_{i,max}$	-	-	7	A
Quiescent Input Current (Vin = 24V)	$I_{i,Qsnt}$	-	120	180	mA
Standby Input Current	$I_{i,stdby}$	-	4	6	mA
Inrush Transient	I^2t	-	-	1.0	A^2s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance)	-	-	10	-	mA
Input Ripple Rejection (120 Hz)	-		60	-	dB
Input Turn-on Voltage Threshold	-	16.5	17	18	V
Input Turn-off Voltage Threshold	-	15	16	16.5	V
Input Voltage ON/OFF Hysteresis	-		1	2	V

Output Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Output Voltage Set Point	Vo		3.3		Vdc
Output Voltage Set Point Accuracy (Vi = 24 V; Io = Iomax; Ta = 25°C)	-	-2		+2	%Vo
Output Voltage Set Point Accuracy (over all conditions)	-	-3		+3	%Vo
Output Regulaton:					
Line Regulation (Vi = 18V to 36V, Io = 1/2 of full load)	-	-	0.2	0.5	%Vo
Load Regulation (Io = Io,min to Io,max, Vi = 24V)	-	-	0.2	0.5	%Vo
Temperature (Ta = -55°C to 100 °C)	-	-	0.1		%Vo
Output Ripple and Noise Voltage					
RMS	-	-	-	30	mVrms
Peak-to-peak (5 Hz to 20 MHz bandwidth, Vin = 48V)				105	mV_{p-p}
External Load Capacitance	-	-	-	15,000	µF
Output Current	Io	0	-	25	A
Output Power	Po	0		82.5	W

Output Specifications (continued)

Parameter	Symbol	Min	Typ	Max	Unit
Output Current-limit Trip Point (Vo = 90% of Vo,nom)		103%	-	150%	Io_max
Output Short-circuit Current			0		A
Efficiency (Vi = 24V; Io = Iomax, T_A = 25ºC)	η	88	90	-	%
Output Over Voltage trip point (% of output set point)		115%	125%	150%	Vo_set
Switching frequency	-	280	300	320	kHz
Dynamic Response (Vi = 24V; Ta = 25°C; Load transient 0.1A/µs)					
Load step from 50% to 75% of full load:					
Peak deviation			5		%Vo
Settling time (to 10% band of Vo deviation)			150		µs
Load step from 50% to 25% of full load					
Peak deviation			5		%Vo
Settling time (to 10% band of Vo deviation)			150		µs

General Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Remote Enable					
Negative Logic:					
Logic Low – Module On Logic High – Module Off	-	-	-	-	-
Positive Logic:					
Logic High – Module On Logic Low – Module Off	-	-	-	-	-
Logic Low:					
$I_{ON/OFF}$ = 1.0mA	$V_{ON/OFF}$	0	-	1.2	V
$V_{ON/OFF}$ = 0.0V	$I_{ON/OFF}$	-	-	1.0	mA
Logic High: $I_{ON/OFF}$ = 0.0µA	$V_{ON/OFF}$	-	-	15	V
Leakage Current	$I_{ON/OFF}$	-	-	50	µA
Turn-on Time (Io = full load, Vo within 1% of setpoint)		-	4	8	ms
Output Voltage Trim Range	-	80	-	110	%Vo
Output Voltage Remote-sense Range	-	-	-	0.5	V
Over-temperature Protection	To	-	120	-	°C
Isolation Capacitance	-	-	1200	-	pF
Isolation Resistance	-	10	-	-	MΩ
Calculated MTBF (Bellcore TR-332)			3.2		10^6-hour

Feature Descriptions

The converter can be turned on and off by changing the voltage between the ON/OFF pin and Vin(-). The SA24 Series of converters is available with factory selectable positive logic and negative logic.

For the negative control logic, the converter is ON when the ON/OFF pin is at a logic low level and OFF when the ON/OFF pin is at a logic high level. For the positive control logic, the converter is ON when the ON/OFF pin is at a logic high level and OFF when the ON/OFF pin is at a logic low level.

With the internal pull-up circuitry, a simple external switch between the ON/OFF pin and Vin(-) can control the converter. A few example circuits for controlling the ON/OFF pin are shown in Fig. 1,2and 3.

The logic low level is from 0V to 1.2V and the maximum switch current during logic low is 1mA. The external switch must be capable of maintaining a logic-low level while sinking up to this current. The maximum voltage at the ON/OFF pin generated by the converter internal circuitry is less than 15V. The maximum allowable leakage current is 50μA.

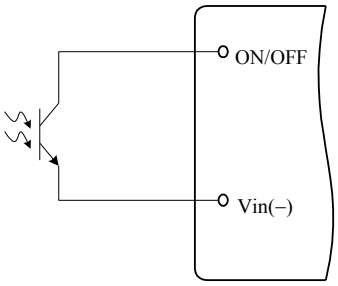


Fig. 1 Opto Coupler Enable Circuit

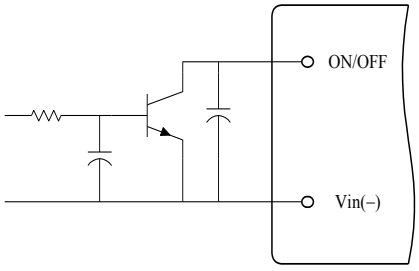


Fig. 2 Open Collector Enable Circuit

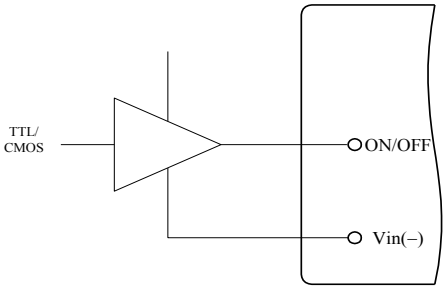


Fig. 3 Direct Logic Drive

Remote SENSE

The remote SENSE pins are used to sense the voltage at the load point to accurately regulate the load voltage and eliminate the impact of the voltage drop in the power distribution path.

SENSE(+) and SENSE(-) pins should be connected to the point where regulation is desired. The voltage between the SENSE pins and the output pins must not exceed 0.5V:

[Vout(+) - Vout(-)] - [SENSE(+) - SENSE (-)] < 0.5V

When remote sense is not used, the SENSE pins should be connected to their corresponding output terminals (positive and negative). If the SENSE pins are left floating, the converter will deliver an output voltage slightly higher than its specified typical output voltage. Since the OVP (output over-voltage protection) circuit senses the voltage across the output pins (Pin 8 and Pin 4), the total voltage rise should not exceed the minimum OVP setpoint given in the Specifications table.

Output Voltage Adjustment (Trim)

The trim pin allows the user to adjust the output voltage set point. To increase the output voltage, an external resistor is connected between the TRIM pin and SENSE(+). To decrease the output voltage, an external

resistor is connected between the TRIM pin and SENSE(-). The output voltage trim range is 80% to 110% of its specified nominal output voltage. The circuit configuration for trim down operation is shown in Fig.6.

$$Rdown = (\frac{511}{\Delta} - 10.22)(k\Omega)$$

Where

$$\Delta = (\frac{|Vnom - Vadj|}{Vnom}) \times 100$$

and

V_{nom} = Nominal Voltage
V_{adj} = Adjusted Voltage

The circuit configuration for trim up operation is shown in Fig.7.

To increase the output voltage, the value of the resistor should be

$$Rup = (\frac{5.11Vo(100 + \Delta)}{1.225\Delta} - \frac{511}{\Delta} - 10.22)(k\Omega)$$

Where Vo = Nominal Output Voltage

As the output voltage at the converter output terminals are higher than the specified nominal level when using the trim up and/or remote sense functions, it is important not to exceed the maximum power rating of the converter as given in the Specifications table.

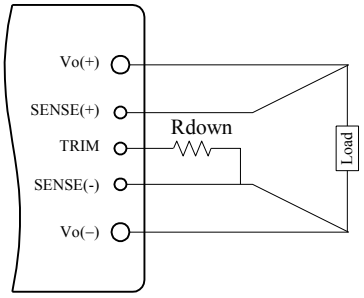


Fig. 4 Circuit to Decrease Output Voltage

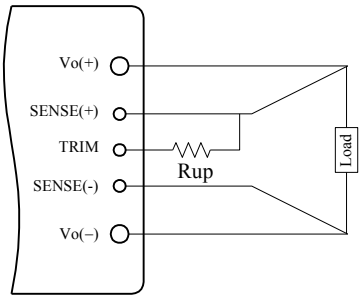


Fig. 7 Circuit to Increase Output Voltage

Input Under-Voltage Lockout

This feature prevents the converter from turning on until the input voltage reaches 17 V typical, and shuts down the converter if the input voltage falls below 16V typical. The 1V hysteresis prevents oscillations.

Output Over-Current Protection

As a standard feature, the converter will latch off when the load current exceeds the current limit. The converter can be restarted by toggling the ON/OFF switch or recycling the input voltage. With the auto-restart option, the converter will operate in a hiccup mode (repeatedly try to restart) until the over-current condition is cleared.

Output Over-Voltage Protection

If the voltage across the output pins exceeds the output voltage protection threshold as given in the Specifications table, the converter will shut down to protect the converter and the load.

As a standard feature, the converter will shut down and latch off when this fault occurs. The converter can be restarted by toggling the ON/OFF switch or recycling the input voltage. With the auto-restart option, the converter will operate in a hiccup mode until the over-voltage cause is cleared.

Thermal Shutdown

As a standard feature, the converter will shut down and latch off if an over-temperature condition is detected. The converter has a temperature sensor located at a

carefully selected position in the converter circuit board, which represents the thermal condition of key components of the converter.

The thermal shutdown circuit is designed to turn the converter off when the temperature at the sensor reaches 120°C. The module can be restarted by toggling the ON/OFF switch or recycling the input voltage. With the auto-restart option, the converter will resume operation after the converter cools down.

Design Considerations

Input Source Impedance

As with any DC/DC converter, the stability of the SA24 converters may be compromised if the source impedance is too high or inductive. It's desirable to keep the input source ac-impedance as low as possible. Although the converters are designed to be stable without an additional input capacitor for typical source impedance, it is recommended to use at least a 33 - 100 μF low ESR electrolytic capacitor at the input of the converter to reduce the potential impact of the source impedance. This electrolytic capacitor should have sufficient RMS current rating over the operating temperature range.

Safety Considerations

The SA24 Series of converters are designed in accordance with EN 60950 Safety of Information Technology Equipment Including Electrical Equipment. The converters are recognized by UL in both USA and Canada to meet 1500V Basic Insulation requirements in UL 60950, Safety of Information Technology Equipment and applicable Canadian Safety Requirement, and ULc 60950. Flammability ratings of the PWB and plastic components in the converter meet 94V-0.

To protect the converter and the system, an input line fuse is highly recommended on the un-grounded input end.

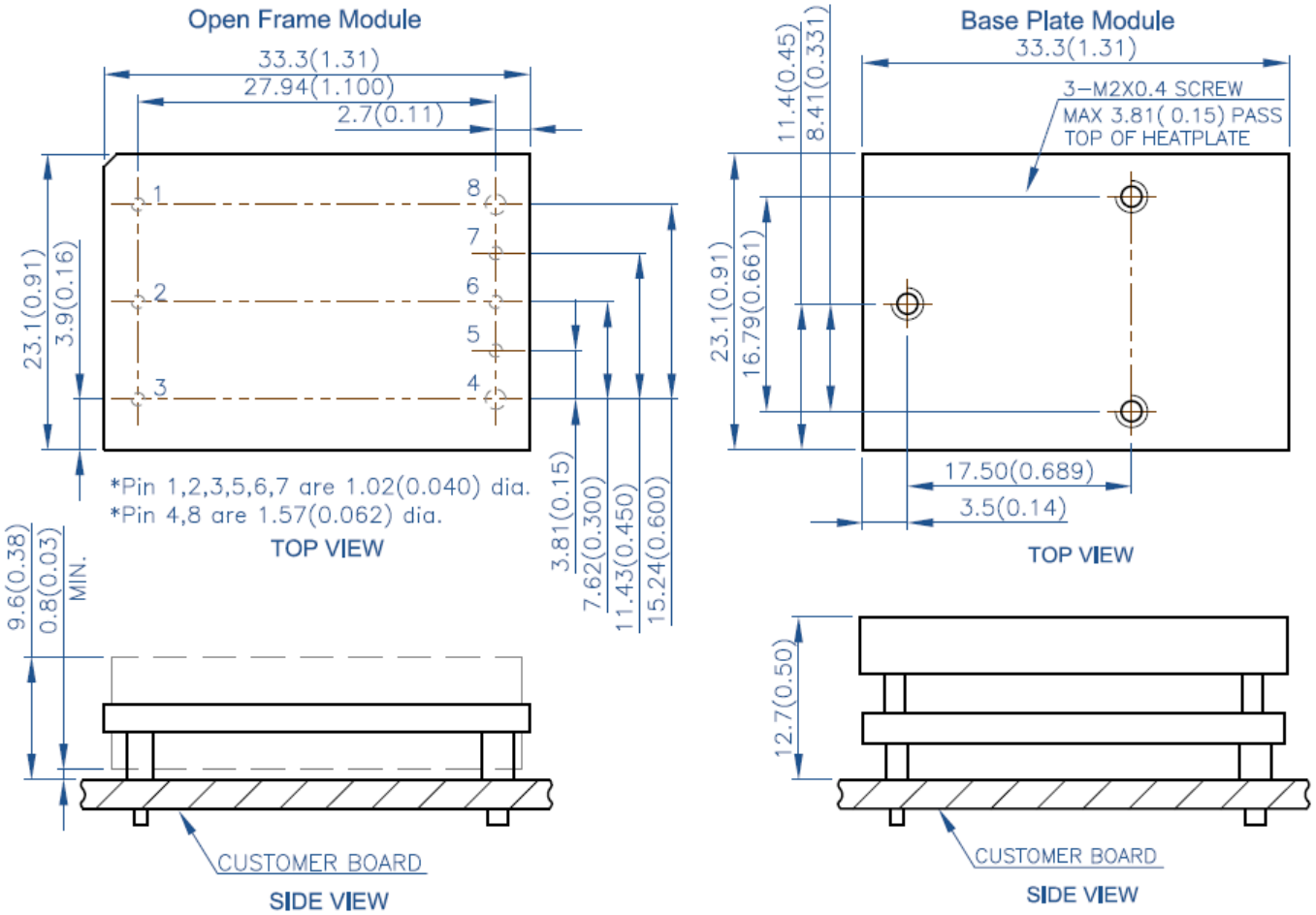
A maximum rating of 5A normal-blow fuse should be connected at the un-grounded input lead of each SA24 converter.

Thermal Considerations

The SA24 Series of converters can operate in various thermal environments. Due to the high efficiency and optimal heat distribution, these converters exhibit excellent thermal performance. Proper cooling can be verified by monitoring the temperature of the case not continuously exceeding 120 °C.

The maximum allowable output power of any power converter is usually determined by the electrical design and the maximum operating temperature of its components.

Mechanical Diagrams

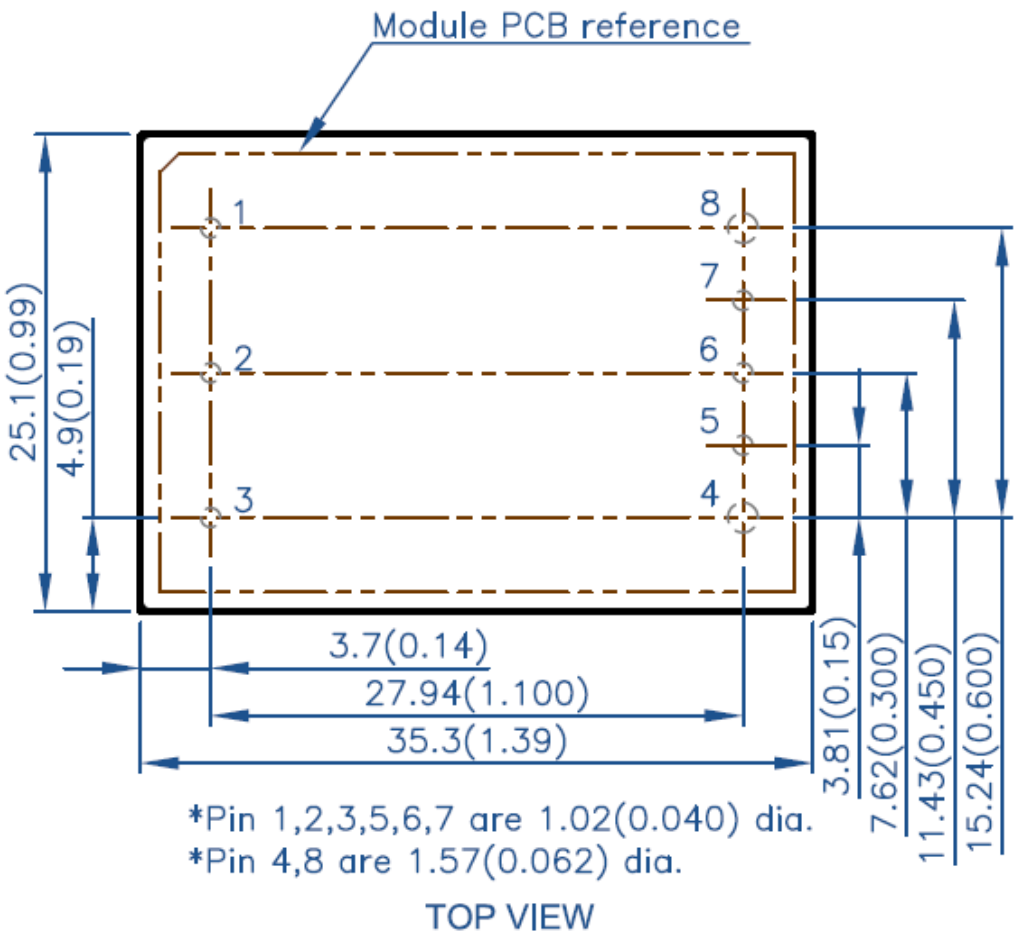


Pin	Name	Function
1	Vin(+)	Positive input voltage
2	ON/OFF	Remote control
3	Vin(−)	Negative input voltage
4	Vout(−)	Negative output voltage
5	SENSE(−)	Negative remote sense
6	TRIM	Output voltage adjust
7	SENSE(+)	Positive remote sense
8	Vout(+)	Positive output voltage

Notes:

All dimensions in mm (inches)
Tolerances: x ± .5 (.xx ± 0.02)
.xx ± .25 (.xxx ± 0.010)

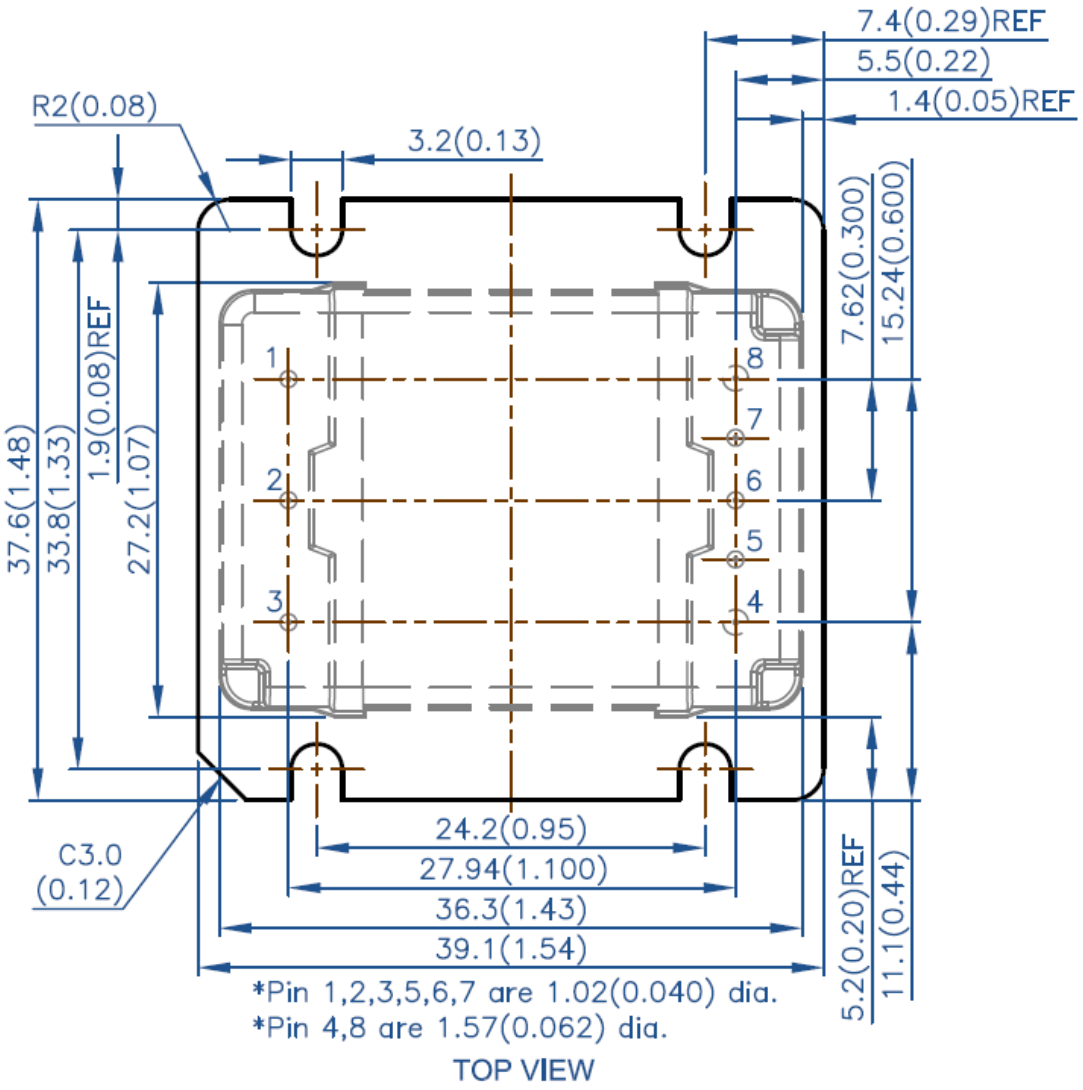
Encapsulated Type-I
(without mounting holes)

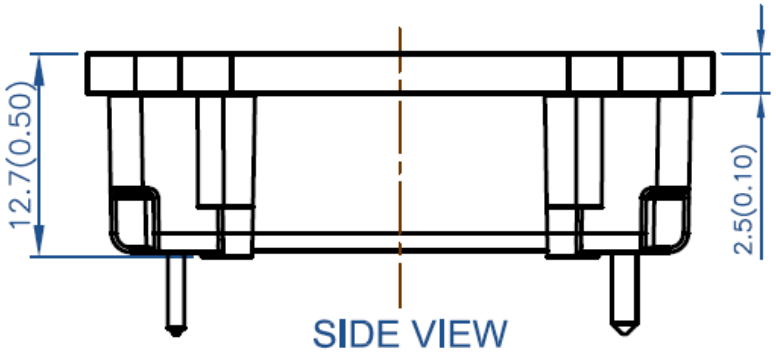


TOP VIEW

SIDE VIEW

Encapsulated Type-II
(with mounting holes)





For more information, please contact Dr. Power's China Representative:

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Warranty

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